

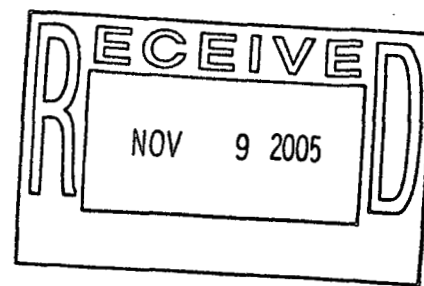
**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
AUTOMATED SURFACE-WATER MONITORING**

**Water Year 2003 Annual Report  
and  
Water Year 2004 Source Evaluations for Points of  
Evaluation GS10, SW027, and SW093**

**U.S. DEPARTMENT OF ENERGY  
Rocky Flats Environmental Technology Site  
Golden, Colorado**

**FINAL**

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## 1. EXECUTIVE SUMMARY

This Report presents the data collected to satisfy selected surface-water monitoring objectives implemented at the Rocky Flats Environmental Technology Site (RFETS or Site) in accordance with the *Rocky Flats Cleanup Agreement* (RFCA, [CDPHE et al, 1996]) and the *RFETS Integrated Monitoring Plan FY2003* (IMP; Kaiser-Hill, 2002). The IMP provides a framework for monitoring in support of closure activities at the Site. This framework includes implementation of a high-resolution surface-water monitoring program that supports data-driven decisions determined by the IMP Data Quality Objectives (DQO) process. The automated surface-water monitoring program provides:

- Monitoring of multiple parameters for the safe and effective operation of the Site retention ponds
- Monitoring of flows and contaminant levels in subdrainages to facilitate the identification of contaminant sources
- Monitoring of various surface-water parameters at various locations on an Ad Hoc basis in support of special projects and/or building operations
- Monitoring of indicator parameter values at various locations to determine correlations between indicator parameters and analytical water-quality measurements
- Routine monitoring of point source discharges and reporting of results in compliance with the National Pollutant Discharge Elimination System (NPDES) permit program to control the release of pollutants into the waters of the United States
- Detection of a release of contaminants from specific projects within the Industrial Area (IA)
- Detection of statistically significant increases of contaminants in surface water from within the IA in general
- Detection of contaminants in comparison to RFCA Action Levels in discharges entering Stream Segment 5 and the Site retention ponds
- Detection of contaminants in comparison to RFCA Standards in discharges entering Stream Segment 4 and at the Site boundary
- Monitoring of indicator parameters in discharges leaving the Site boundary as a prudent management action, and
- Monitoring of flows and water quality in the Buffer Zone (BZ) for ecological and water rights issues, closure planning and design, as well as supporting studies regarding the interaction between media

This report provides a comprehensive and detailed summary of the automated surface-water monitoring conducted at RFETS, which fulfills the applicable requirements of the Site IMP. As such, this report is organized to follow the framework of the IMP, with each report section providing the objective-specific data evaluations.

This report includes all data collected during WY03. The term 'water year' (abbreviated as WY) is defined as the period from October 1 through September 30. For example, WY03 refers to the period from 10/1/02 through 9/30/03.

This report also includes more recent data (WY04 data) specifically used in Section 6: Source Location Monitoring as specifically related to ongoing source evaluations. The source evaluation presentation in Section 6 is intended to fulfill the Site's requirement to perform timely source evaluations in response to reportable values at Points of Evaluation (POEs) GS10, SW027, and SW093 during WY04. The WY04 Annual Report will include evaluation of all data collected during WY04 in addition to the WY04 Source Evaluation data presented herein.

## 1.1 MONITORING HIGHLIGHTS: WY03

During WY03, the automated surface-water monitoring network successfully fulfilled the targeted monitoring objectives as required by the Site IMP. During the year, four new monitoring locations were installed to provide increased monitoring resolution as the Site moves toward closure. By the end of the water year the network consisted of 62 unique locations. During WY03 these locations collected 441 composite samples composed of 23,455 individual grabs.<sup>1</sup>

WY03 was somewhat drier than average with approximately 11.4 inches of precipitation, which is 89% of average. The spring was wetter than average with March and April being 166% of average. During this period the Site experienced a large blizzard during the third week of March. The largest events occurred on 4/19/03 (1.26") and 5/10/03 (0.58").<sup>2</sup> The largest two-day total (1.26") occurred on 4/19 - 4/20/03. October was somewhat wetter than average, while both July and September were significantly drier than average. The highest peak flow rates for the year from the IA was during the 3/23/03 snowmelt (estimated at 23.4 cubic feet per second [cfs]) in South Walnut Creek, and the 4/19/03 runoff (estimated at 17.3 cfs) in North Walnut Creek.

Several monitoring locations at the Site have flumes that have been installed for many years were beginning to show signs of deterioration during WY02. As such, the Site had identified two locations, based on their relative importance to the overall Site monitoring goals, as locations warranting replacement. The locations scheduled for flume replacement in FY03 were POC GS03 and POE SW093.

The existing rectangular weir at SW093 was replaced with a 3-foot H-flume. This type of flume was chosen based on expected flow rates to be measured, the ability to pass debris, and a wide range of accurate flow measurement. The new flume is capable of accurately measuring flows from nearly zero to 31 cfs. Although 31 cfs is below many of the historically estimated peak flow rates at SW093, the reduction of impervious surfaces as the Site moves toward closure will result in smaller peak flow rates. Consultation with the Site-Wide Water Balance modeling team has confirmed this assumption.

The existing Parshall flumes at GS03 were replaced with a single 3-foot HL flume. This flume was chosen based on expected flow rates to be measured, the ability to pass debris, and a wide range of accurate flow measurement. The new flume is capable of accurately measuring flows from nearly zero to 60 cfs.

All water-quality data at the RFCA Points of Compliance (POCs) were well below the applicable standards during WY03. For the RFCA POEs, water-quality data were below the applicable action levels at SW027 and 995POE during WY03, with reportable Pu values at GS10 and SW093. These reportable values for WY03 were addressed through updated Source Evaluations in the WY02 Annual Automated Surface-Water Monitoring Report. During WY04, POEs GS10, SW027, and SW093 all showed reportable periods for both Pu and Am. Though routine data evaluation for WY04 data will be presented in the WY04 Annual Report, updated Source Evaluations in response to the WY04 reportable period are included in this report. These WY04 reportable periods are addressed in Section 6 of this report.

Conclusions for the WY04 POE Source Evaluations are:

- Based on the details regarding recent Site activities, it is concluded that various D&D, construction, ER, and excavation operations resulted in increased transport of low-level contamination associated with suspended solids in surface water that are likely to have resulted in the recent reportable values measured at the GS10, SW027, and SW093.

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<sup>1</sup> Composite samples consist of multiple aliquots ('grabs') of identical volume. Each grab is delivered by the automatic sampler to the composite container at each predetermined flow-volume or time interval.

<sup>2</sup> The precipitation gages used in the Automated Surface-Water Monitoring Network are not heated due to the lack of AC power at the locations. As such, the gages do not accurately measure snowfall (as water equivalent) as it occurs. Therefore, the precipitation (snow) associated with the March blizzard was not accurately measured. The gages measured approximately 1.7" of moisture during the melt period.

contaminant concentrations in surface water and in other media. The IMP is required under RFCA to further define the monitoring programs for the Site.

To align the surface-water monitoring program with the new RFETS mission and RFCA requirements, the monitoring network was evaluated in 1996. The DQO process was used to determine what decisions were necessary for surface water and the function of each location in the network in supporting those decisions. DOE, CDPHE, EPA, and stakeholders were directly involved in decisions involving the monitoring network. Results of this evaluation were integral to the development of the IMP, which is discussed below.

#### **2.4.3 Integrated Monitoring Plan for Surface Water**

The Site automated surface-water monitoring network is designed to meet the requirements documented in the Site IMP, which groups all Site surface-water monitoring objectives into five primary categories: Site-Wide, Industrial Area, Industrial Area Discharges to Ponds, Water Leaving the Site, and Off-Site. The ten IMP objectives that are accomplished through the automated monitoring as detailed in the annual Rocky Flats Environmental Technology Site Automated Surface-Water Monitoring Work Plans (SSOC, 2002b) are described briefly below.<sup>3,4</sup> During WY03, the Site monitoring network included 62 monitoring locations (Figure 2-1) to achieve these objectives.<sup>5</sup> In some situations, the same location may serve multiple objectives. Monitoring tasks and data collection, compilation, evaluation, and reporting for each objective included in this report are detailed in Sections 6 through 15.

The IMP used the DQO process to determine necessary and sufficient monitoring requirements. The process yielded multiple, data-driven, surface-water monitoring objectives (called decision rules under the DQO process), a subset of which (10) is implemented through automated monitoring. The remaining IMP objectives are implemented by other RFETS projects and governmental agencies. Some decisions need a higher priority than others, and some need greater confidence. The DQO process produced descriptions that expose the strengths and weaknesses of each data-driven decision and the value of the data (resources required) in making each decision. Management decisions often must be made based on incomplete information. The individual DQO sections of the IMP document guide management in establishing funding priorities for surface-water monitoring objectives.

Five of the IMP automated surface-water monitoring objectives are organized in a roughly upstream-to-downstream direction, beginning with Performance monitoring within the IA and ending downstream at the POCs at Indiana Street (Figure 2-2). These monitoring objectives are summarized in the following paragraphs and are discussed in detail in Sections 10 through 14.

For the first of the upstream-to-downstream monitoring categories (IA Objectives), the IMP requires the Site to characterize significant surface-water releases within the IA. Within the IA (usually), individual high-risk projects will sometimes warrant Performance monitoring (Section 10) to detect a spill or release of contaminants specifically associated with that project.

For the next upstream-to-downstream monitoring category (IA Discharges to Ponds / Segment 5 Objectives), the IMP requires the Site to identify and correct significant accidental or undetected releases of contaminants from the IA to the Site retention ponds (surface water leaving the IA and entering Segment 5). The New Source Detection (Section 10.3.12) and POE (Section 12) objectives deal with discharges from the IA to the ponds. In order to decide whether a significant release has occurred, the Site performs NSD monitoring of IA runoff for significant increases in contaminants. Additionally, RFCA specifies Stream Segment 5 / POE monitoring for the upstream

<sup>3</sup> The IDLH decision rule (locations indicated in Table 2-1; included in the RFETS Automated Surface-Water Monitoring Work Plans) requires the collection of hydrologic data to support the management of the Site retention ponds. This objective does not require any detailed data analysis. Therefore, this decision rule is not included in this report, however, hydrologic data is presented here for completeness.

<sup>4</sup> Data evaluation from the NPDES monitoring is also included here for the completeness. Additional details on the implementation of NPDES monitoring can be found in the applicable NPDES permit.

<sup>5</sup> The period of operation of these locations varies based on project needs and regulatory requirements.

reaches of Site drainages (above the ponds) and specifies action levels for contaminants (Action Level Framework).

The next category is Water Leaving the Site (Segment 4 Objectives). The Site is required to monitor at POC locations below the terminal ponds to protect state stream standards in Segment 4 (Section 13), as specified in RFCA. In addition, there are RFCA POCs that are located at the Site boundary at Indiana Street (Section 13) for both Walnut and Woman Creeks. The Non-POC decision rule (Section 14) also requires the Site to collect data for selected water-quality parameters at the Indiana Street POCs.

Monitoring objectives that do not fit into the upstream-to-downstream sequence are considered as Site-Wide Monitoring Objectives. Monitoring in support of these objectives can occur at any location within the Site boundary.

For example, Imminent Danger to Life and Health (IDLH) monitoring provides information necessary for safe operation of the Site retention pond dams. This monitoring objective is not discussed in this document, however the hydrologic data associated with this decision rule are presented in Section 3.

Table 4-3 and Figure 4-2 show that median Am activities for the majority of locations outside the IA are below the action level of 0.15 pCi/L<sup>10</sup>. Outside the IA, only GS51 and SW055 had median activities greater than 0.15 pCi/L. These activities are likely due to the proximity of these monitoring location drainage areas to the 903 Pad. Several locations within the IA showed median Am activities greater than 0.15 pCi/L.

**Table 4-3. Summary Statistics for Am-241 Analytical Results in WY97-03.**

Location	Samples [N]	Median [pCi/L]	85 <sup>th</sup> Percentile [pCi/L]	Maximum [pCi/L]
GS01	131	0.002	0.008	0.039
GS03	215	0.005	0.016	0.059
GS08	93	0.005	0.013	0.275
GS10	211	0.055	0.157	8.39
GS11	82	0.003	0.008	0.047
GS21	8	0.007	0.008	0.019
GS22	19	0.005	0.011	0.019
GS27	66	0.387	1.80	15.0
GS28	10	0.025	0.036	0.068
GS31	22	0.010	0.020	0.116
GS32	66	0.482	2.21	4.06
GS38	59	0.022	0.040	0.087
GS39	51	0.023	0.067	0.237
GS40	66	0.031	0.075	2.64
GS42	8	0.130	0.170	0.200
GS43	26	0.008	0.018	0.045
GS44	31	0.015	0.025	0.064
GS49	24	0.009	0.023	0.050
GS50	7	0.127	0.206	0.442
GS51	10	0.596	1.14	2.11
GS52	6	0.067	0.128	0.129
GS53	5	0.124	4.90	11.9
GS54	2	0.002	0.002	0.002
GS55	30	0.003	0.011	0.013
GS56	7	0.002	0.004	0.005
GS57	21	0.002	0.012	0.015
GS59	11	0.000	0.003	0.004
GS60	1	0.007	NA	NA
SW021	2	0.026	0.038	0.043
SW022	71	0.023	0.080	1.76
SW027	53	0.007	0.020	0.177
SW036	14	0.001	0.002	0.004
SW055	14	0.266	0.701	13.5
SW091	21	0.043	0.200	0.686
SW093	235	0.008	0.033	0.628
SW119	14	0.064	0.105	0.384
SW120	26	0.052	0.139	3.13
995POE	34	0.003	0.009	0.025

<sup>10</sup> The action levels noted in this section only apply to POEs (995POE, GS10, SW027, and SW093; Section 12) compared to 30-day averages. The same numeric values are applied as standards only at POCs (GS01, GS03, GS08, GS11, and GS31; Section 13) compared to 30-day averages. Comparisons of standards and action levels to other locations are noted in this section for reference only. POEs and POCs are highlighted in **bold** in the tables.

Table 4-4 and Figure 4-3 show that median total uranium activities for all but one location are below the action level of 10 pCi/L (11 pCi/L for Woman Creek).<sup>11</sup> Location SW036 showed median activities greater than the action level. This activity is likely due to the proximity of SW036 to the Original Landfill. Locations GS32, GS43, SW119, and SW120 showed sample results greater than the action level. These activities are likely due to the proximity of GS43 to Building 886 and GS32, SW119, and SW120 to the Solar Ponds. Similarly, the higher results measured at SW021, SW091, SW093, and SW119 are also likely due to their proximity to the Solar Ponds. GS44 measures footing drain flows from B771, baseflow for GS55 is sustained by footing drain flows from B881, and baseflow for both GS10 and GS40 is sustained by footing drain flows from the 700 Area. The measurements at these locations may be due to naturally occurring uranium in the intercepted groundwater.

**Table 4-4. Summary Statistics for Total Uranium Analytical Results in WY97-03.**

Location	Samples [N]	Median [pCi/L]	85 <sup>th</sup> Percentile [pCi/L]	Maximum [pCi/L]
GS01	17	1.83	4.37	5.89
GS03	32	1.55	2.26	3.27
GS08	93	1.20	1.98	4.58
GS10	217	3.02	4.43	7.20
GS11	83	2.05	3.08	4.06
GS21	9	0.568	0.729	1.17
GS22	20	1.17	3.20	7.32
GS27	67	0.354	1.07	3.89
GS28	10	0.819	1.08	1.15
GS31	22	2.28	2.63	3.92
GS32	68	1.75	3.76	21.2
GS38	19	0.528	0.866	1.20
GS39	14	0.286	0.977	1.24
GS40	45	3.12	4.20	11.3
GS42	6	0.189	0.292	0.300
GS43	23	2.49	10.6	23.1
GS44	31	2.40	4.45	5.24
GS49	24	0.325	0.933	2.93
GS50	7	0.292	0.355	0.438
GS51	10	1.26	2.54	2.76
GS52	6	2.66	3.15	3.78
GS53	5	1.22	2.33	3.67
GS54	2	0.113	0.126	0.131
GS55	30	3.22	4.99	9.45
GS56	7	1.40	2.39	3.70
GS57	21	0.391	0.730	2.39
GS59	11	0.497	1.09	3.87
GS60	1	0.625	NA	NA
SW021	2	4.88	5.75	6.12
SW022	71	0.860	2.06	3.91
SW027	53	1.71	3.05	4.48
SW036	14	30.2	36.6	39.6
SW055	14	1.21	2.94	4.50
SW091	21	3.21	5.06	6.97
SW093	238	2.72	4.19	6.64
SW119	15	2.70	7.48	10.6
SW120	27	3.07	7.71	10.3
995POE	35	0.359	1.09	1.84

<sup>11</sup> The action levels noted in this section only apply to POEs (995POE, GS10, SW027, and SW093; Section 12) compared to 30-day averages. The same numeric values are applied as standards only at POCs (GS01, GS03, GS08, GS11, and GS31; Section 13) compared to 30-day averages. Comparisons of standards and action levels to other locations are noted in this section for reference only. POEs and POCs are highlighted in **bold** in the tables.

## 5. LOADING ANALYSIS

This section provides a summary of actinide loads for RFCA POEs and POCs. These locations collect continuous flow paced composite samples for laboratory analysis. The nature of the continuous sampling during all flow conditions allows for more accurate load estimations compared to storm-event sampling. The activity for each composite sample (pCi/L) is multiplied by the corresponding stream discharge (L) during the composite sample period, to yield the load (pCi). The total pCi value is then converted to micrograms ( $\mu\text{g}$ ) using the conversion factors in Table 5-1.<sup>12</sup> A detailed description of the method for load estimation is given in Appendix B1: Data Evaluation Methods.

**Table 5-1. Activity to Mass Conversion Factors for Pu, Am, and U Isotopes.**

Analyte	Mass/Activity (g/Ci)
Pu-239,240	14.085
Am-241	0.292
U-233,234	1.6 E+02
U-235	4.63 E+05
U-238	2.98 E+06

The Pu-239,240 conversion factor was derived from Table 2.7.2-2 in the April 1980 *Final Environmental Impact Statement (Final Statement to ERDA 1545-D)*, Rocky Flats Plant Site.

The conversion factors for Am-241, U-233,234, U-235, and U-238 were taken from the *U.S. Code of Federal Regulations, Title 40, Chapter I, Part 302.4, Appendix B, October 7, 2000*.<sup>13</sup>

### 5.1 SITE-WIDE

This section summarizes the calculated site-wide Pu and Am loads for selected locations. Total uranium data collection began at GS01 and GS03 at the beginning of WY03, as such only WY03 data are shown. The following points are noted:

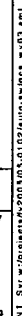
- Figure 5-1 shows that the Site retention ponds are effective at removing Pu from the water column. The A- and B-Series Ponds remove 69% of the Pu load from the IA in Walnut Creek, while Pond C-2 removes 74% of the Pu load from the IA in Woman Creek. For lower Walnut Creek, there is a small calculated Pu loss between the terminal ponds and GS03. For lower Woman Creek, however, there is a significant gain in Pu load between Pond C-2 and GS01. This is likely due to transport of diffuse, low-level Pu contamination in the much larger flow volumes measured at GS01 (2013 acre-feet [ac-ft] at GS01; 206 ac-ft at GS31). The volume-weighted Pu activity of 0.006 pCi/L at GS01 is significantly below the standard of 0.15 pCi/L.
- Figure 5-2 shows that the Site retention ponds are effective at removing Am from the water column in Walnut Creek. The A- and B-Series Ponds remove 86% of the Am load from the IA in Walnut Creek. However, Pond C-2 only removes a calculated 16% of the Am load from the IA in Woman Creek. This small removal is likely due to the small loads measured and the near detection limit activities introducing measurement error. Additionally, the routine testing of the outlet works at Pond C-2 results in higher Am concentrations being discharged (the outlet works intake is located very close to the pond bottom sediments), though the 30-day Am averages have not been reportable compared to the 0.15 pCi/L standard. For lower Walnut Creek, there is a small calculated Am gain between the terminal ponds and GS03. For lower Woman Creek, however, there is a significant gain in Am load between Pond C-2 and GS01. This is likely due to transport of diffuse, low-

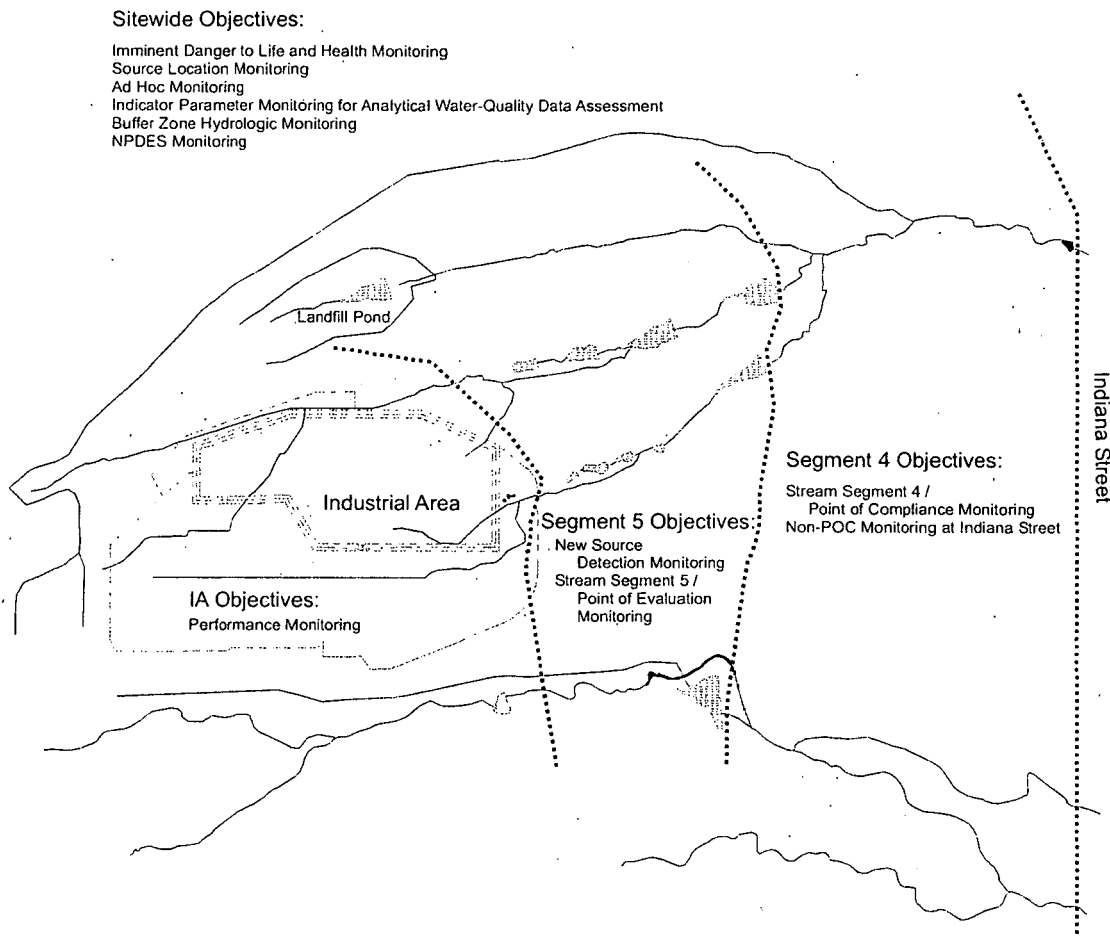
<sup>12</sup> In the following tables and plots, values are rounded for clarity.

<sup>13</sup> The U-234 conversion factor was used to represent U-233,234 due to the small relative abundance of U-233.

level Am contamination in the much larger flow volumes measured at GS01 (2013 ac-ft at GS01; 206 ac-ft at GS31). The volume-weighted Am activity of 0.004 pCi/L at GS01 is significantly below the standard of 0.15 pCi/L.

- Uranium analysis at both GS01 and GS03 began in WY03. Figure 5-3 shows that the Site retention ponds have very little effect on uranium activities. Since uranium is far more likely to be transported as a dissolved constituent, this lack of removal due to physical settling is expected. In fact, the site retention ponds show a slight gain in total uranium loads, likely caused by groundwater entering the ponds. For lower Walnut Creek, there is a 21% calculated uranium gain between the terminal ponds and GS03. For lower Woman Creek, however, there is a much larger 511% gain in uranium load between Pond C-2 and GS01. This is likely due to naturally occurring uranium in the much larger flow volumes measured at GS01 (2013 ac-ft at GS01; 206 ac-ft at GS31). The volume-weighted total uranium activity of 1.24 pCi/L at GS01 is significantly below the standard of 11 pCi/L.





**Figure 2-2. Conceptual Model of Site Automated Surface-Water Monitoring Objectives.**

Another site-wide monitoring objective, Source Location monitoring (covered in Section 6), is designed to locate a source of contamination detected by other monitoring objectives, and can take place anywhere within the Site boundary. Unplanned, special-request monitoring activities are discussed as Ad Hoc monitoring in Section 7. For example, monitoring may be performed at various locations to evaluate alternatives for surface-water management, such as controlled-retention pond management or re-routing of wastewater treatment plant (WWTP) effluent. Similarly, monitoring may need to be performed to provide data to special projects such as the AME and the Site-Wide Water Balance.

Indicator Parameter Monitoring for Analytical Water-Quality Data Assessment (Section 8) is also implemented site-wide. This objective provides the justification for the collection of general water-quality and quantity information to be used for various data assessments. Specifically, this objective outlines the current and expected uses of parameters such as total suspended solids (TSS), turbidity, and flow rate.

The NPDES permit program controls the release of pollutants into the waters of the United States and requires routine monitoring of point source discharges and reporting of results (Section 8.4). The Site's first NPDES permit was issued by EPA in 1974. The permit was reissued by EPA in 1984, expired in 1989, and administratively extended through April 2001. The current NPDES permit became effective 5/1/01 and required an update to the RFCA Action Level Framework by adding a new POE at the WWTP (995POE). All for NPDES compliance is prescriptively required by EPA and is not covered by the IMP process. For covered by this report, NPDES monitoring is performed at six locations (two locations after 5/1/01).

Finally, Buffer Zone Hydrologic monitoring occurs at various locations across the Site and addresses interfaces between surface water and other media: soil, groundwater, air, and ecology (Section 15).

Location Code	Supported Decision Rule										Precipitation
	IDLH	Source Location	Ad Hoc	Indicator Parameter	Performance	New Source Detection	POE	POC	Non-POC	BZ Hydro	
RPTR2											✓
RPTR3											✓

Note: NPDES locations are not included in this table since all monitoring for NPDES compliance is prescriptively required by EPA and is not covered by the IMP process.

Many locations provide flow data to the Site-Wide Water Balance as Ad Hoc locations. Only those locations specifically installed as Ad Hoc locations are noted above.

Locations A3DM, A4DM, B5DM, C2DM, and LFDM are telemetry nodes collecting real-time pond level and piezometer data for the IDLH decision rule. No data are reported in this report.

## 2.5 SETTING

### 2.5.1 Site Description

The Site is a government-owned, contractor-operated facility in the DOE nuclear weapons complex, located in Golden, Colorado. The Site is owned by the DOE, managed by the DOE Rocky Flats Project Office (DOE, RFPO), and operated by Kaiser-Hill, L.L.C. (K-H). The RFCA surface-water monitoring program is managed and implemented by the Water Programs Group of URS, Corp. (URS), under contract to K-H.

This automated surface-water monitoring program is implemented at multiple locations throughout the Site. Figure 2-1 shows the locations of the automated surface-water monitoring locations operated during WY03 that are included in this report.

### 2.5.2 Hydrology

Streams and seeps at RFETS are largely ephemeral, with stream reaches gaining or losing flow, depending on the season and precipitation amounts. Surface-water flow across RFETS is primarily from west to east, with three major drainages traversing the Site. Fourteen retention ponds (plus several small stock ponds) collect surface-water runoff, although only ten ponds are actively managed. The Site drainages and retention ponds, including their respective pertinence to this report, are described below and shown in Figure 2-3.

#### Walnut Creek

Walnut Creek receives surface-water flow from the central third of RFETS, including the majority of the IA. It consists of several tributaries: McKay Ditch, No Name Gulch, North Walnut Creek, and South Walnut Creek. These tributaries join Walnut Creek prior to the RFETS eastern boundary (Indiana Street). East of Indiana Street, Walnut Creek flows through a diversion structure normally configured to divert flow to the Broomfield Diversion Ditch around Great Western Reservoir and into Big Dry Creek. The Walnut Creek tributaries, from north to south, are described below:

##### McKay Ditch

The McKay Ditch was formerly a tributary to Walnut Creek within the RFETS boundaries but was diverted in July 1999 into a new pipeline to keep McKay Ditch water from co-mingling with RFETS water in Walnut Creek. Although no longer a contributor to Walnut Creek, the McKay Ditch drainage is described here to clarify water routing at the Site. The new configuration allows the City of Broomfield to transport water from the South Boulder Diversion Canal, across the northern Rocky Flats BZ and directly into Great Western Reservoir without entering Walnut Creek. This configuration prevents commingling of McKay water with discharged water from the Site retention ponds.

##### No-Name Gulch

This drainage is located downstream of the Present Landfill and Landfill Pond. A surface-water diversion ditch was constructed around the perimeter of the Present Landfill in 1974 to divert surface-water runoff around the landfill and reduce infiltration of surface water into the landfill.

On the north side of the landfill, the ditch runs under a perimeter road through a small culvert and east into a small, natural drainage that eventually joins No Name Gulch below the Landfill Pond dam. On the south side of the landfill, the ditch runs east above the Landfill Pond and drops into No Name Gulch below the dam. The Landfill Pond covers approximately 2.5 acres. Surface-water from the landfill and from the area surrounding the pond is a major contributor to pond water. Some portion of the runoff is diverted by the surface-water diversion ditch, while a significant fraction flows to the Landfill Pond. Water is periodically transferred to the A-Series Ponds to control the water level in the Landfill Pond. Runoff from the IA does not flow into this basin.

### **North Walnut Creek**

Runoff from the northern portion of the IA flows into this drainage, which has four retention ponds (Ponds A-1, A-2, A-3, and A-4). The combined capacity of the A-Series Ponds is approximately 197,000 cubic meters ( $m^3$ ) (52 million gallons [160 acre-feet]). In the normal operational configuration, Ponds A-1 and A-2 are bypassed and maintained for emergency spill control; evaporation or transfer controls water levels in these ponds. Pond A-1 also receives water pumped from the Landfill Pond roughly once per year. North Walnut Creek flow is diverted around Ponds A-1 and A-2 to Pond A-3 for detainment and settling of solids. Pond A-3 is discharged in batches to the A-Series "terminal pond", Pond A-4. After filling to a maximum safe level (typically approximately 50 percent of capacity), Pond A-4 water is isolated, sampled, and released if downstream surface-water quality criteria are met. These off-site discharges, each averaging approximately 49,000  $m^3$  (12.9 million gallons [39.6 acre-feet]), typically occur 2 to 4 times per year.

### **South Walnut Creek**

Runoff from the central portion of the IA flows into this drainage, which has five retention ponds (Ponds B-1, B-2, B-3, B-4, and B-5). The combined capacity of the South Walnut Creek B-Series Ponds is approximately 102,000  $m^3$  (27 million gallons [83 acre-feet]). Ponds B-1 and B-2 are bypassed and maintained for emergency spill control; evaporation or transfer controls water levels in these ponds. Until October 2004, Pond B-3 received effluent from the Site's WWTP and flows into Pond B-4. South Walnut Creek flow is diverted around Ponds B-1, B-2, and B-3, and into Pond B-4, which flows continuously into "terminal pond" Pond B-5. After filling to a maximum safe level, Pond B-5 is released in batches of approximately 49,000  $m^3$  (12.9 million gallons [39.6 acre-feet]) to South Walnut Creek. Pond B-5 discharges typically occur 6 to 8 times per year.

### **South Interceptor Ditch**

South of the IA is the South Interceptor Ditch (SID)/Woman Creek drainage system. Although it is tributary to Woman Creek, the SID warrants more thorough discussion than other comparable tributaries at the Site because it captures runoff from the southern portion of the IA, a drainage basin that includes the Original Landfill and the 903 Pad.

Surface-water runoff from the southern portion of the IA is captured by the SID, which flows from west to east into Pond C-2. After 1992, Pond C-2 was pump discharged to the Broomfield Diversion Ditch after reaching a pre-designated level. Starting in January 1997, water from Pond C-2 is sampled and, if downstream surface-water quality is met, pump discharged into Woman Creek which flows to the Woman Creek Reservoir. (See the Woman Creek description below.) These off-site discharges from Pond C-2, each averaging approximately 42,400  $m^3$  (11.2 million gallons [34.4 acre-feet]), typically occur once per year.

### **Woman Creek**

South of the SID is Woman Creek, which flows through Pond C-1 and off-site at Indiana Street. The Woman Creek drainage basin extends eastward from the base of the foothills, near Coal Creek Canyon, to Standley Lake.

In the current configuration, Woman Creek flows into the Woman Creek Reservoir located upstream of Standley Lake, where the water is held until it is pump transferred to Big Dry Creek by the City of Westminster.

### **Other Drainages**

The third major drainage at the Site, other than Walnut and Woman Creeks, is Rock Creek. The Rock Creek drainage covers the northwestern portion of the Site's BZ. East sloping alluvial plains to the west, several small stock ponds within the creek bed, and multiple steep gullies and stream channels to the east characterize the drainage channel. This basin receives no runoff from the IA.

Smart Ditch, located south of Woman Creek, is also hydrologically isolated from the IA. The D-Series Ponds (D-1 and D-2) are located on Smart Ditch. This drainage and these ponds are not discussed in this report.

**Figure 2-3**  
Automated Surface Water  
Monitoring Locations  
and Precipitation Gages  
for Water Year 2003  
in Woman, Walnut  
and Rock Creeks

**EXPLANATION**

- ◆ Precipitation Gage
- ▲ Automated Surface Water Monitoring Location
- Major Drainage Basins

**Standard Map Features**

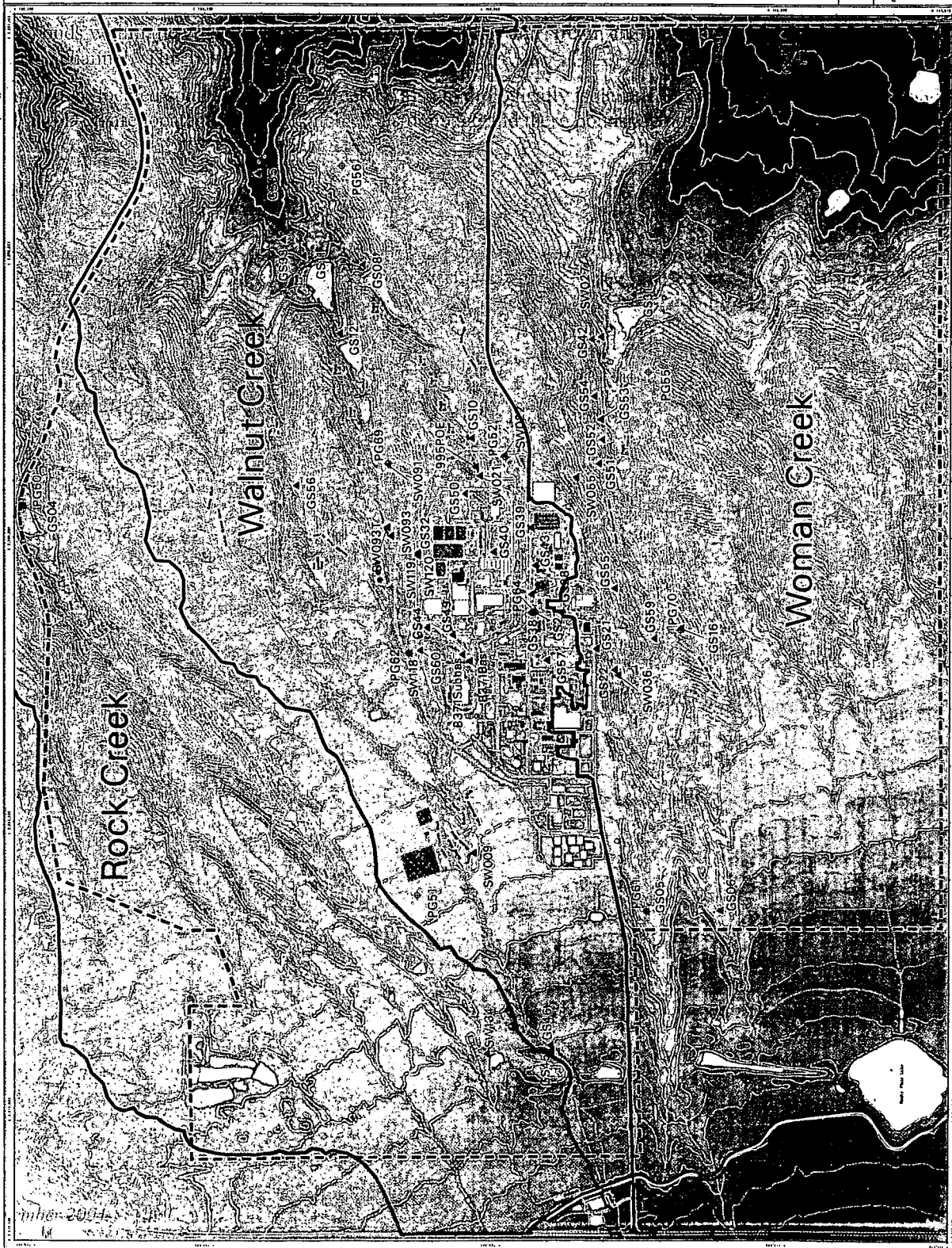
- Buildings and other structures
- Remotely sensed buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Rocky Flats Environmental Technology Site boundary
- Roads

**DATA SOURCES AND REFERENCES**  
This map was prepared using data from the following sources:  
Topographic data: 1:250,000 scale, 1984 edition, U.S. Geological Survey, Denver, CO.  
Automated surface water monitoring locations: Data provided by the U.S. Army Corps of Engineers, Vicksburg, MS.  
Precipitation gage locations: Data provided by the National Weather Service, Norman, OK.  
Major drainage basins: Data provided by the U.S. Geological Survey, Reston, VA.  
Rocky Flats Environmental Technology Site boundary: Data provided by the U.S. Department of Energy, Rocky Flats Environmental Technology Site, Golden, CO.  
Roads: Data provided by the U.S. Geological Survey, Reston, VA.

Scale: 1:100,000  
1 inch represents approximately 10 miles



U.S. Department of Energy  
Rocky Flats Environmental Technology Site  
GIS Dept. 352-000 7707  
Prepared by:  
CH2M HILL  
Kaiser-Hill  
March 20, 2003



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### 3. HYDROLOGIC DATA

The following section provides information on all automated surface-water monitoring locations at RFETS operating during WY03. Some locations do not have continuous flow record; they were operated only to collect automated surface-water samples for laboratory analysis. For locations with continuous flow measurement, graphical discharge summaries are given below. Numerical discharge values are included in the tables in Appendix A. The hydrologic routing diagrams for the locations included in this report are given in Figure 3-1 and Figure 3-2.

#### 3.1 DATA PRESENTATION

##### 3.1.1 Discharge Data Collection and Computation

The data obtained at a continuous surface-water gaging station on a stream or conveyance, such as an irrigation ditch, consist of a continuous record of stage<sup>6</sup>, individual measurements of discharge throughout a range of stages, and notations regarding factors that might affect the relation of stage to discharge. These data, together with supplemental information such as climatological records, are used to compute daily mean discharges.

Continuous records of stage are obtained with electronic recorders that store stage values at selected time intervals or secondarily with radio-telemetry data-collection platforms that transmit near real-time data at selected time intervals to a central database for subsequent processing. Direct field measurements of discharge are made with current meters, using methods adapted by the USGS as a result of experience accumulated since 1880, or with flumes or weirs that are calibrated to provide a relation of observed stage to discharge. These methods are described by Carter and Davidian (1968) and by Rantz and others (1982).

In computing discharge records for non-standard flow-control devices, results of individual measurements are plotted against the corresponding stage, and stage-discharge relation curves are constructed. From these curves, rating tables indicating the computed discharge for any stage within the range of the measurements are prepared. For standard devices (e.g. flumes, weirs), rating tables indicating the discharge for any stage within the range of the device are prepared based on the geometry of the device. If it is necessary to define extremes of discharge outside the range of the device, the curves can be extended using (1) Logarithmic plotting, (2) velocity-area studies, (3) results of indirect measurements of peak discharge, such as slope-area or contracted-opening measurements, and computation of flow over dams or weirs, or (4) step-back-water techniques.

Daily mean discharges are computed by averaging the individual discharge measurements using the stage-discharge curves or tables. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features that form the control, the daily mean discharge is determined by the shifting-control method, in which correction factors based on the individual discharge measurements and notes by the personnel making the measurements are applied to the gage heights before the discharges are determined from the curves or tables. This shifting-control method also is used if the stage-discharge relation is changed temporarily because of aquatic vegetation growth or debris on the control. For some gaging stations, formation of ice in the winter can obscure the stage-discharge relations so that daily mean discharges need to be estimated from other information, such as temperature and precipitation records, notes of observations, and records for other gaging stations in the same or nearby basins for comparable periods.

For most gaging stations, there may be periods when no gage-height record is obtained or the recorded gage height is so faulty that it cannot be used to compute daily mean discharge or contents. This record loss occurs when recording instruments malfunction or otherwise fail to operate properly, intakes are plugged, the stilling well is frozen, or various other reasons. For such periods, the daily discharges are estimated from the recorded range in stage, previous or following record, discharge measurements, climatological records, and comparison with other gaging-station records from the same or nearby basins. Information explaining how estimated daily

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<sup>6</sup> Stage is the water level (in units such as feet or meters) in a conveyance structure.

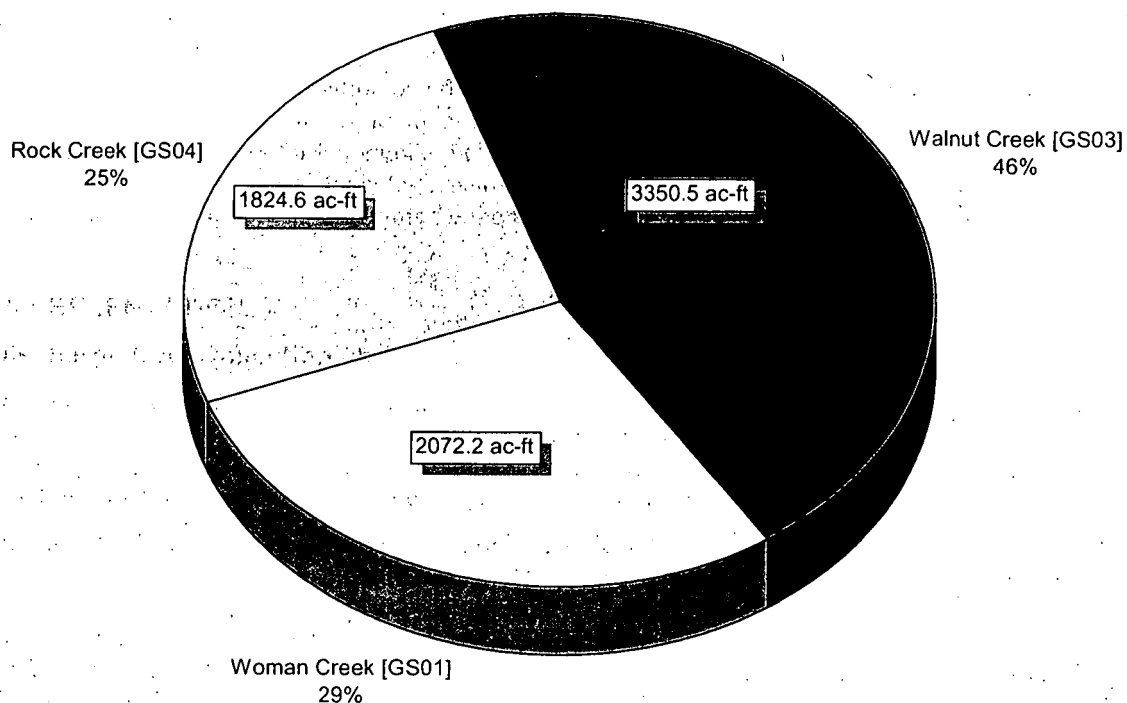


Figure 3-4. Relative Total Discharge Summary from Major Site Drainages: WY97-03.

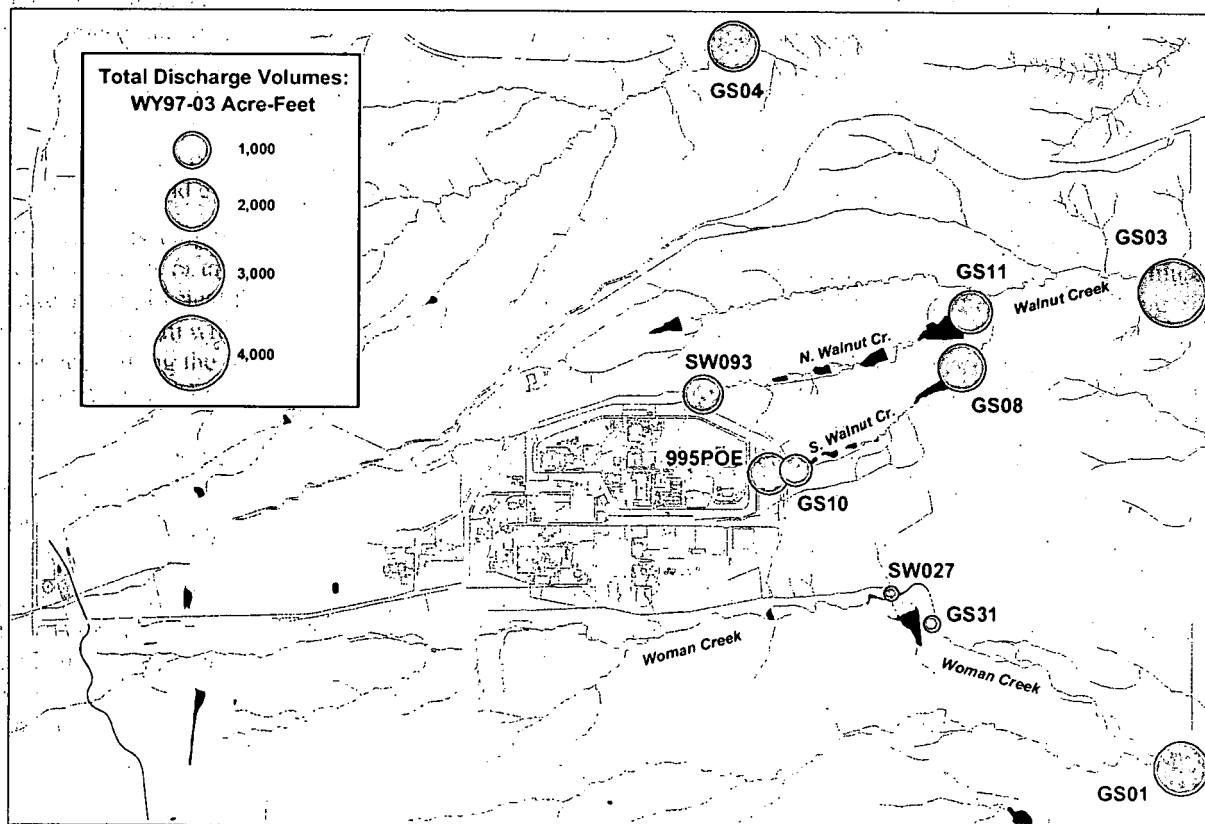


Figure 3-5. Map Showing Relative WY97-03 Discharge Volumes for Selected Gaging Stations.

### 3.2.3 GS01: Woman Creek at Indiana Street

#### Location

Woman Creek 200' upstream of Indiana Street; State Plane: E2093820, N744894

#### Drainage Area

- The basin includes the Woman Creek drainage and southern portions of the IA; areas west of Highway 93 also contribute runoff (total drainage acreage undetermined)
- IA Areas tributary to GS01: 900, 800, 600, and 400

#### Period of Record

9/16/91 to current year

#### Gage

Water-stage recorder and 18" Parshall flume (flume is located just east of Indiana Street, sampling conducted on Site property); prior to 3/24/98 flow measurement was at the onsite sampling location on 9" Parshall flume

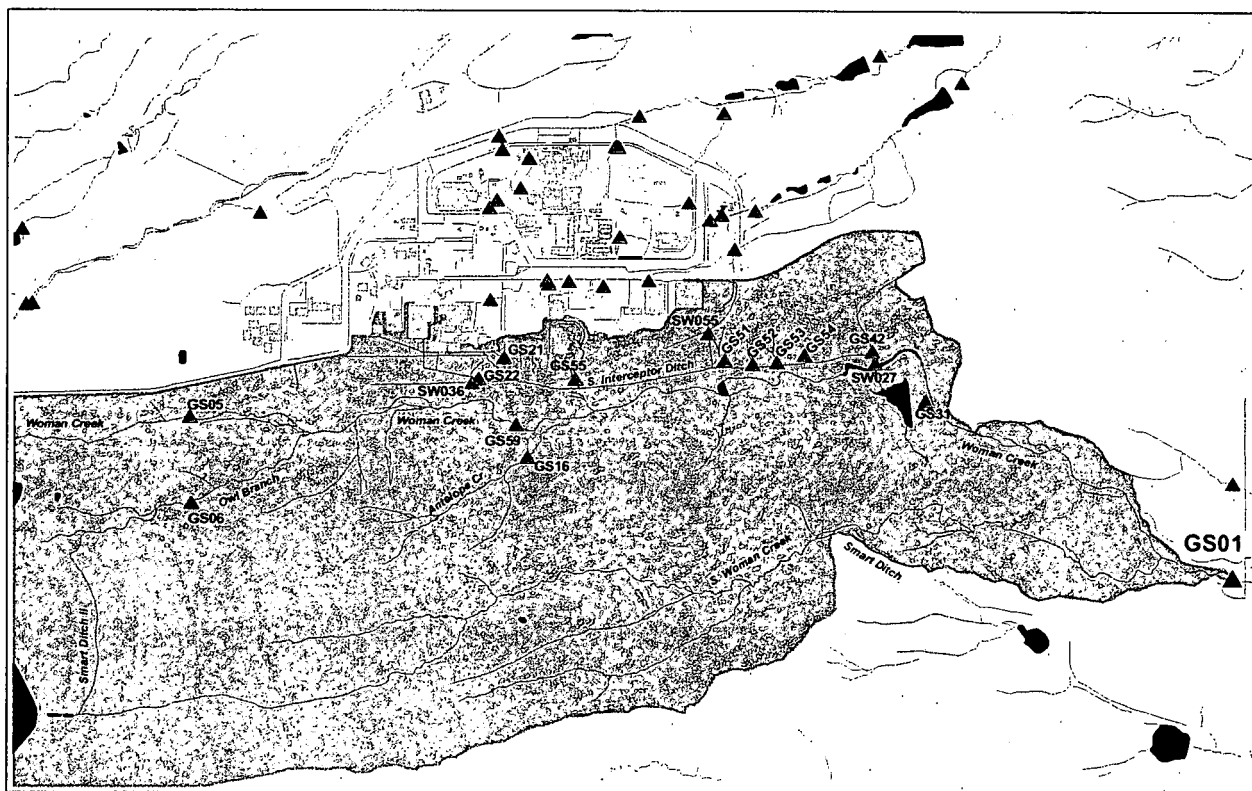


Figure 3-8. Map Showing GS01 Drainage Area.

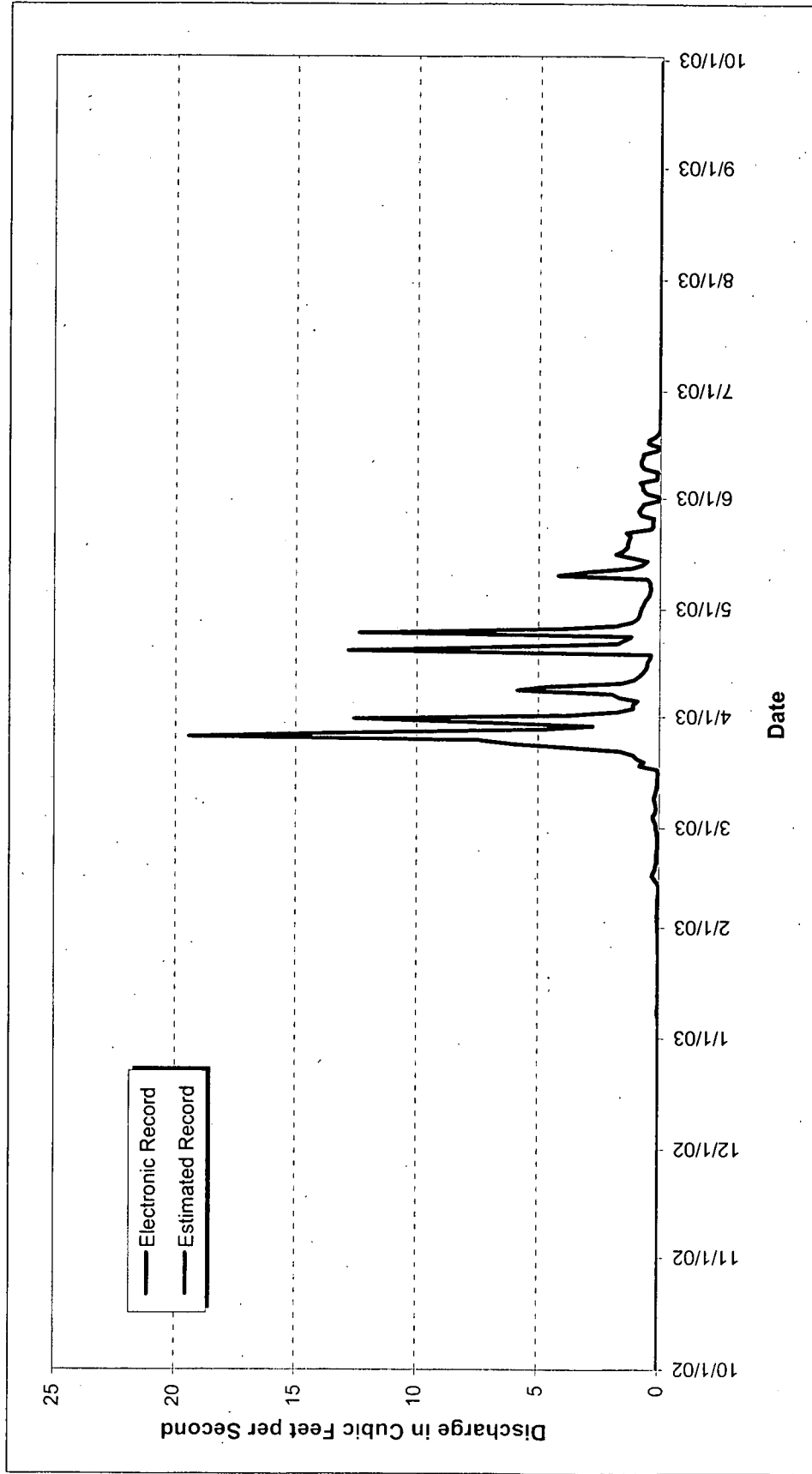


Figure 3-9. WY03 Mean Daily Hydrograph at GS01: Woman Creek at Indiana Street.

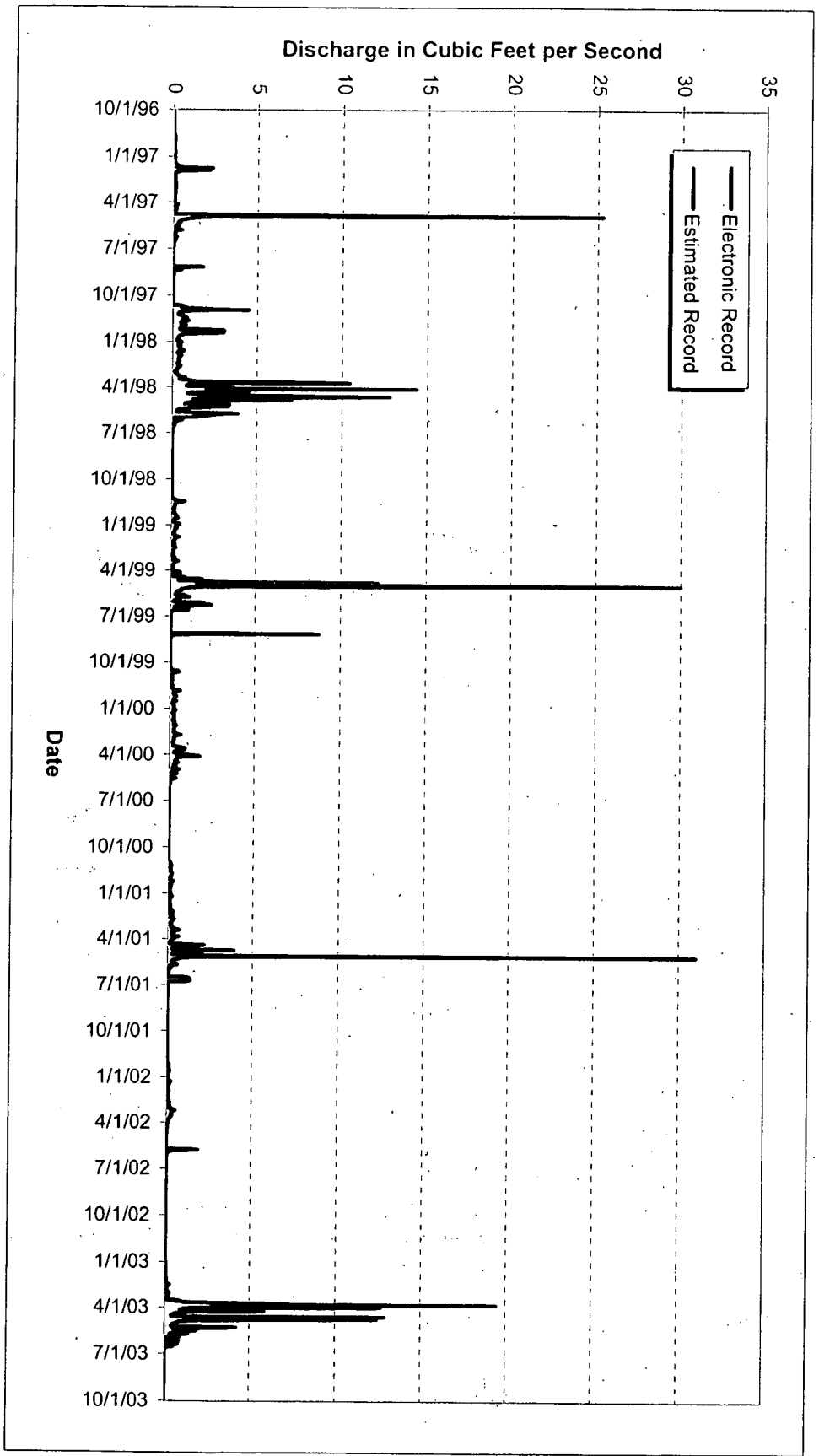


Figure 3-10. WY97-03 Mean Daily Hydrograph at GS01: Woman Creek at Indiana Street.

### 3.2.4 GS02: Mower Ditch at Indiana Street

#### Location

Mower Ditch 200' upstream of Indiana Street; State Plane: E2093817, N746302

#### Drainage Area

- The basin includes areas upgradient of Mower Ditch (total of 157.7 acres)
- IA Areas draining to GS02: none

#### Period of Record

9/16/91 to current year

#### Gage

Water-stage recorder and 9" Parshall flume; weir insert installed 3/8/99

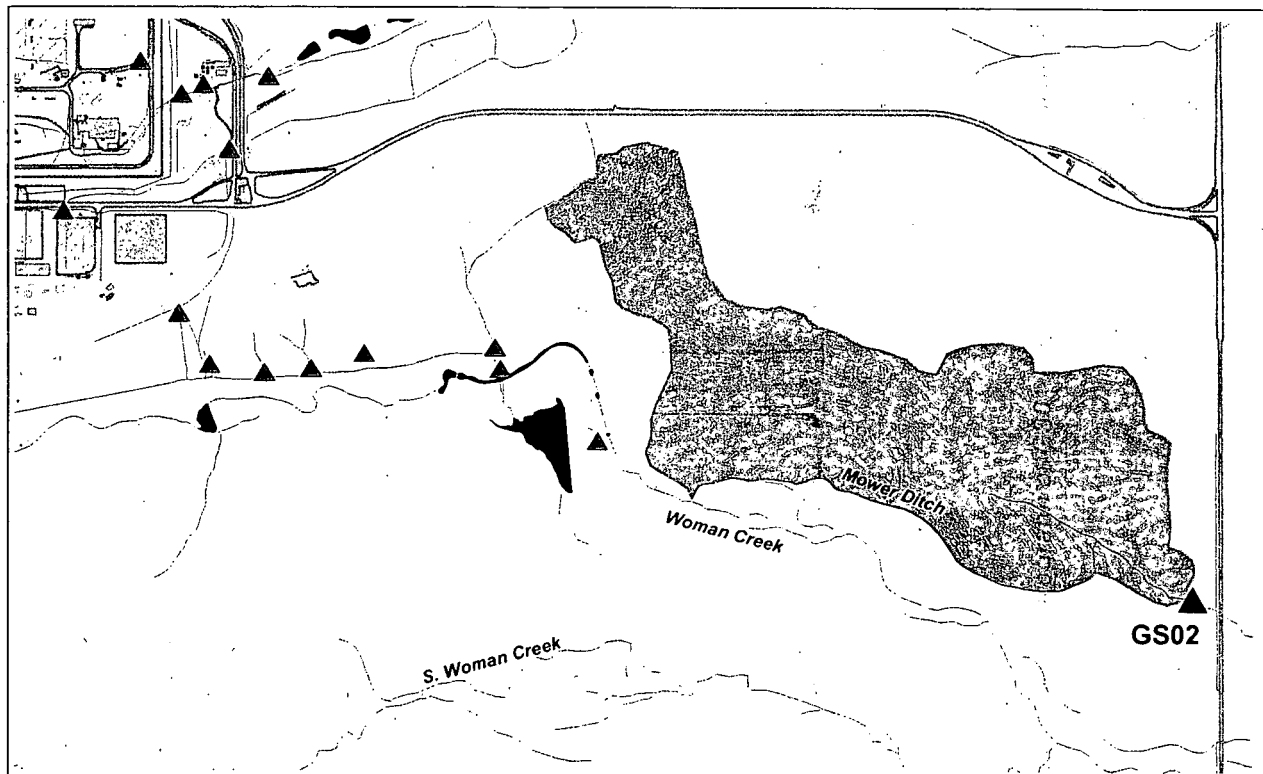


Figure 3-11. Map Showing GS02 Drainage Area.

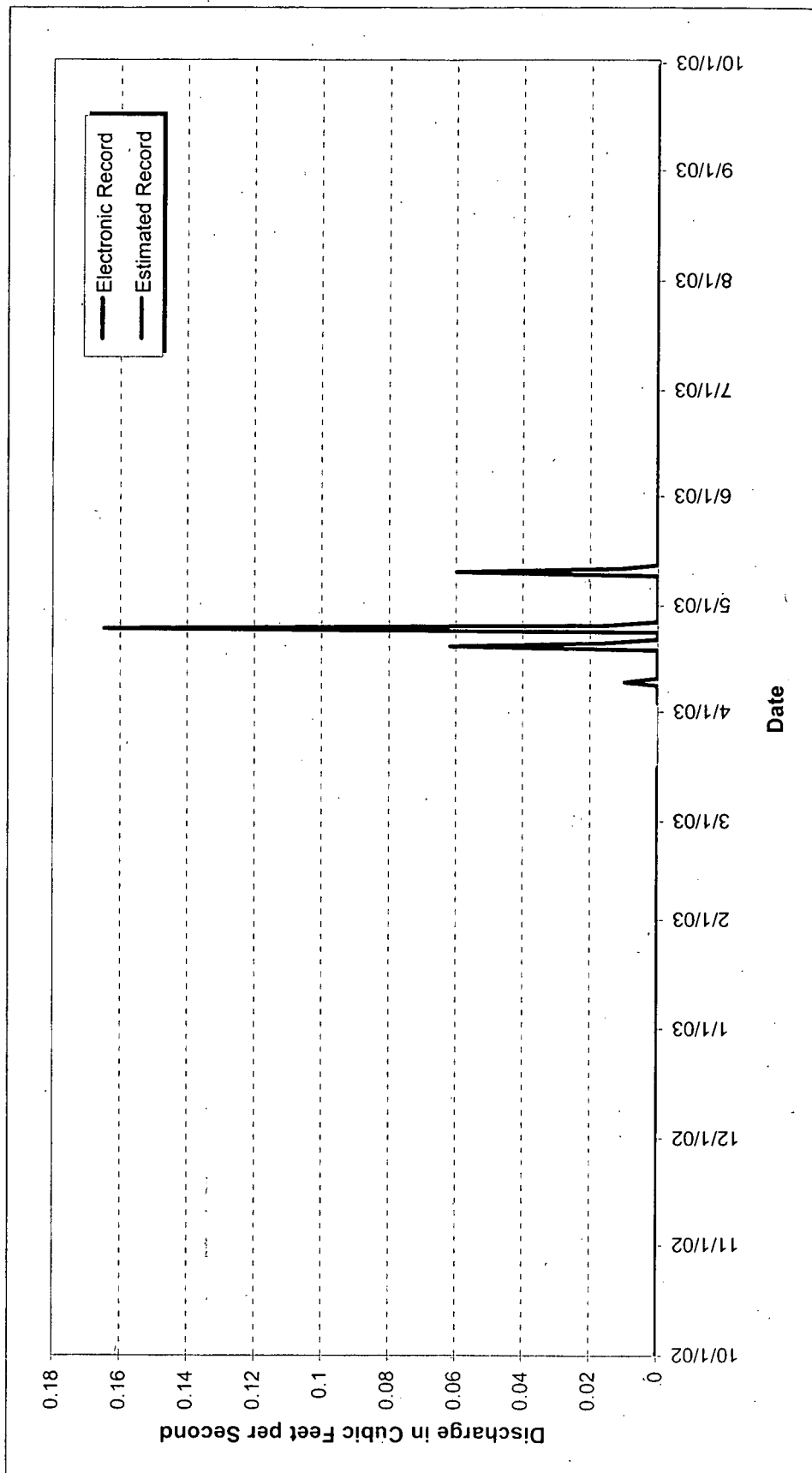
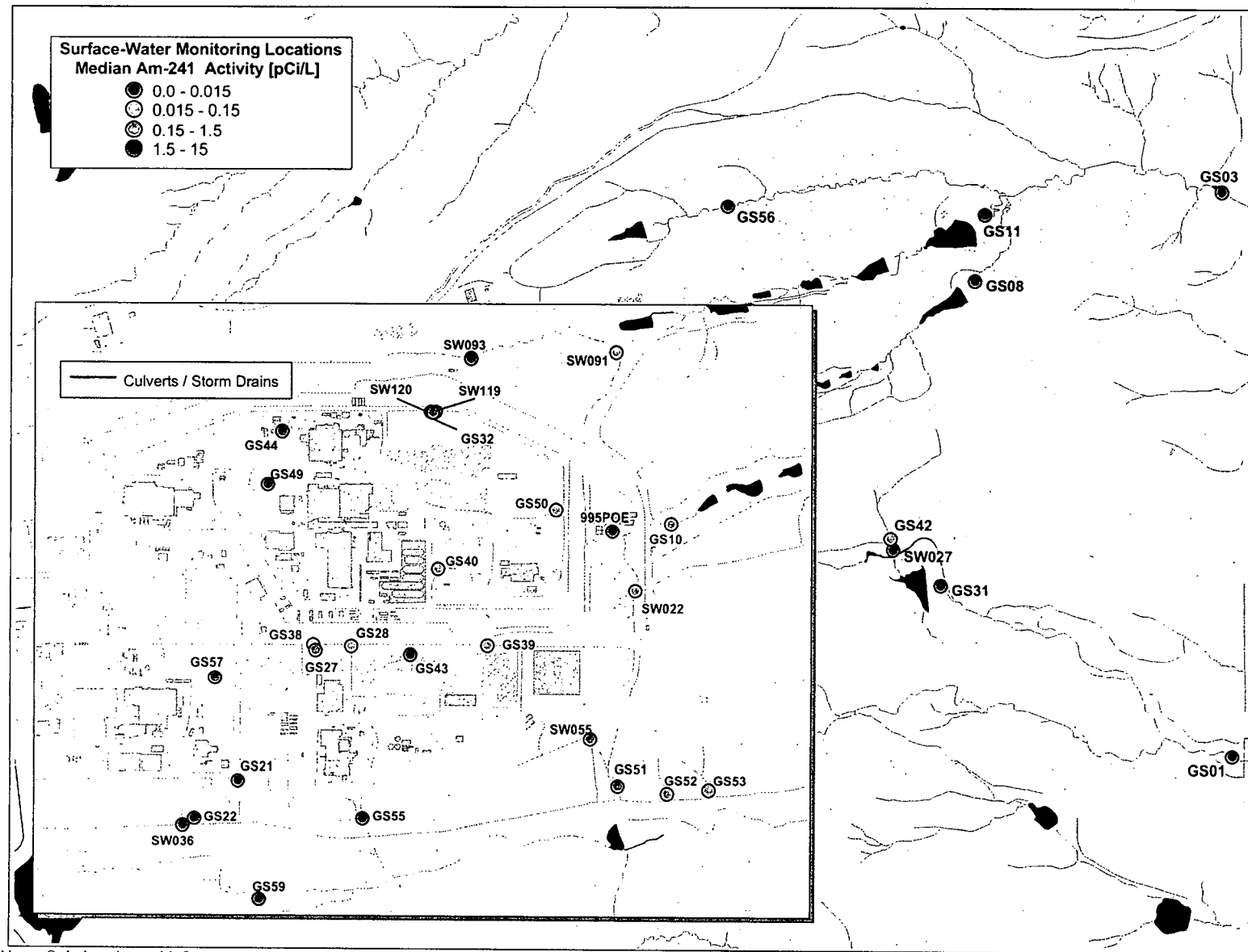


Figure 3-12. WY03 Mean Daily Hydrograph at GS02: Mower Ditch at Indiana Street.



Note: Only locations with four or more results are mapped.

**Figure 4-2. Map Showing Median Am-241 Activities for WY97-03.**

**ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE  
AUTOMATED SURFACE-WATER MONITORING**

**Water Year 2003 Annual Report  
and  
Water Year 2004 Source Evaluations for Points of  
Evaluation GS10, SW027, and SW093**

**U.S. DEPARTMENT OF ENERGY  
Rocky Flats Environmental Technology Site  
Golden, Colorado**

**FINAL**

**December 2004**

## A.1.1 GS01: Woman Creek at Indiana Street

Table A-1. WY03 Discharge Summary for GS01: Woman Creek at Indiana Street.

## Water Year 2003: Daily Mean Discharge Values in Cubic Feet per Second

Day	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
1	0.000	0.000	0.000	0.010	0.043	0.137	3.793	0.737	0.038	0.000	0.000	0.000
2	0.000	0.000	0.000	0.011	0.053	0.177	1.712	0.660	0.550	0.000	0.000	0.000
3	0.000	0.000	0.000	0.007	0.059	0.237	1.079	0.592	0.700	0.000	0.000	0.000
4	0.000	0.000	0.000	0.009	0.058	0.241	1.084	0.464	0.718	0.000	0.000	0.000
5	0.000	0.000	0.000	0.009	0.061	0.151	0.882	0.409	0.819	0.000	0.000	0.000
6	0.000	0.000	0.000	0.010	0.060	0.133	1.641	0.380	0.131	0.000	0.000	0.000
7	0.000	0.000	0.000	0.037	0.056	0.150	1.955	0.380	0.129	0.000	0.000	0.000
8	0.000	0.000	0.000	0.047	0.057	0.194	5.835	0.386	0.108	0.000	0.000	0.000
9	0.000	0.000	0.000	0.039	0.055	0.211	4.720	0.501	0.670	0.000	0.000	0.000
10	0.000	0.000	0.000	0.033	0.031	0.172	1.558	4.180	0.783	0.000	0.000	0.000
11	0.000	0.000	0.000	0.026	0.030	0.133	1.028	2.973	0.779	0.000	0.000	0.000
12	0.000	0.000	0.000	0.029	0.030	0.104	0.822	1.173	0.720	0.000	0.000	0.000
13	0.000	0.000	0.000	0.022	0.074	0.078	0.673	0.713	0.682	0.000	0.000	0.000
14	0.000	0.000	0.000	0.021	0.167	0.070	0.549	0.497	0.123	0.000	0.000	0.000
15	0.000	0.000	0.000	0.023	0.277	0.056	0.500	1.156	0.051	0.000	0.000	0.000
16	0.000	0.000	0.000	0.023	0.245	0.051	0.477	1.819	0.475	0.000	0.000	0.000
17	0.000	0.000	0.000	0.026	0.169	0.117	0.390	1.459	0.459	0.000	0.000	0.000
18	0.000	0.000	0.000	0.023	0.141	0.826	0.354	1.324	0.185	0.000	0.000	0.000
19	0.000	0.000	0.000	0.022	0.113	0.618	12.842	1.307	0.055	0.000	0.000	0.000
20	0.000	0.000	0.000	0.021	0.099	0.937	6.857	1.271	0.022	0.000	0.000	0.000
21	0.000	0.000	0.000	0.020	0.099	1.086	1.731	1.220	0.022	0.000	0.000	0.000
22	0.000	0.000	0.000	0.017	0.103	1.576	1.398	1.369	0.007	0.000	0.000	0.000
23	0.000	0.000	0.000	0.019	0.086	3.704	1.157	0.350	0.005	0.000	0.000	0.000
24	0.000	0.000	0.000	0.022	0.082	6.029	12.412	0.284	0.005	0.000	0.000	0.000
25	0.000	0.000	0.000	0.022	0.074	7.433	4.414	0.299	0.006	0.000	0.000	0.000
26	0.000	0.000	0.000	0.020	0.062	19.426	1.823	0.255	0.004	0.000	0.000	0.000
27	0.000	0.000	0.000	0.021	0.096	13.474	1.138	0.787	0.003	0.000	0.000	0.000
28	0.000	0.000	0.000	0.025	0.126	4.790	0.904	0.872	0.001	0.000	0.000	0.000
29	0.000	0.000	0.000	0.031	NA	2.741	0.828	0.777	0.000	0.000	0.000	0.000
30	0.000	0.000	0.003	0.035	NA	7.585	0.789	0.678	0.000	0.000	0.000	0.000
31	0.000	NA	0.008	0.038	NA	12.615	NA	0.095	NA	0.000	0.000	NA

## Flow Rate

Average	0.000	0.000	0.000	0.023	0.093	2.750	2.511	0.947	0.275	0.000	0.000	0.000
Maximum	0.000	0.000	0.008	0.047	0.277	19.426	12.842	4.180	0.819	0.000	0.000	0.000
Minimum	0.000	0.000	0.000	0.007	0.030	0.051	0.354	0.095	0.000	0.000	0.000	0.000

## Discharge

Cubic Feet	0	0	982	62140	224942	7365840	6509658	2537318	712951	0	0	0
Gallons	0	0	7349	464843	1682685	55100313	48695626	18980461	5333247	0	0	0
Acre-Feet	0.00	0.00	0.02	1.43	5.16	169.10	149.44	58.25	16.37	0.00	0.00	0.00

## Annual Summaries for WY03

Ft <sup>3</sup> /Sec	0.552
GPM	247.8
Cubic Feet	17413833
Gallons	130264524
Acre-Feet	399.77

KEY: WR: No data or unacceptable data due to winter icing conditions  
 BD: Bad data due to equipment failures  
 ITALICS: Italic values contain data estimated from field observations  
 and electronic record at adjacent or comparable gages